

has attained over that which seemed utterly beyond the grasp of man from vastness and remoteness. By the discovery of the laws of molecular action, he will be led to "establish molecular mechanism on a single principle, just as the discovery of the law of universal attraction led him to erect on a single "basis the mechanism of the heavens."

How, indeed, after reviewing the close relationship—the mutual interchangeableness—of the physical forces, is it possible to avoid the conclusion that (in Faraday's memorable words), they have all "one common origin, or rather, are different manifestations of one fundamental power?" And further, it would be hard to reconcile such views of the continuity and varied manifestation of force with the notion of vacuum—of direct action at a distance through a vacuum, that is—though such has hitherto been the usual idea of gravitation. It was not Newton's. He had a far profounder, and, so to speak, more modern idea of it than his successors, as his own emphatic words testify: "That gravity should be innate, inherent, and essential to matter," wrote he, "so that one body may act upon another at a distance, through a vacuum without mediation of anything else by and through which thier action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it." Empty space! it is a delusion. Between us and the sun, between us and the remotest star whose beams strike upon human eyes, there is no void. Though our senses are not so finely attuned as to catch so subtle a reality, we know that through that space comes to us force, light, actinism, heat, gravitation; and, the more earnestly man searches into the modes of action of these, the more impossible it becomes to conceive of their existence apart from matter, any more than that of matter apart from force. It is no novelty to us that matter should be invisible and intangible: not merely is the air we breathe so, but the most dense and solid rock may by the action of intense heat (as in the voltaic arc) pass into that condition. Why then may not matter of a far subtler and more ethereal kind than that of which our atmosphere is composed pervade the regions of space, conveying to us the sweet and mighty influences of sun and stars? Unhappily—yet not, perhaps, unhappily, for it compels boldness to go hand in hand with humility—the profounder the knowledge gained by the man of science of the workings of force and of the composition of matter, the more heavily the conviction presses on him that the true secret of both is beyond his grasp. An unthinking man will grant you readily enough that mind is an inscrutable mystery; but of matter he believes he has a very clear and adequate idea, little dreaming that of that idea one half only is perception, the other half conclusions from perception, which may be true or false. But the physical philosopher, long pondering, experimenting, measuring, testing these objects of our perceptions, comes more and more to distrust the received conclusions; nay, in many cases, to form entirely opposite ones, led especially by the subtle relations of the forces of nature with one another, and the mysterious and indissoluble connexion, perhaps identity (for so have Boscovich and Faraday been tempted to surmise) between matter

and force. Whether man can do more than speculate concerning the nature of these—more than say what they are not, what they may be, but never what they are—whether the most piercing and aspiring intellect must in this direction only beat its wings against the bars, it is not for us to decide. At least it is a gain worth all the toil to recognise vividly that there is a deep mystery not only in that which lives and grows, but in the very stocks and stones. No longer mistaking our own shallow conceptions for complete and absolute truth, our minds may become as a clear unclouded mirror, where in dim and shadowy grandeur some suggestions of this far-off absolute truth will perhaps be reflected.

But to return to the definite and practical aims of science. Hitherto we have glanced at the indestructibility of force in the inorganic world. But the tie between organic and inorganic is so close, the organic being nourished and built up out of the inorganic, that we must look to find the same indestructible forces at work in the one as in the other, though under new conditions, and under the control of that higher agency which we call Vital Force. We take in force in the air we breathe, in the food we swallow. In decomposition these forces are set free, and find new scope for their activities. Hence it is that "decomposition is the handmaid of growth." That slow combustion, for instance, which is the source of animal warmth—the combining of the oxygen of the air with the inflammable constituents of food—witnesses to the continued activity of chemical force within us as without. Yet it must always be borne in mind that in the living organism chemical affinity is controlled and often opposed (else how should organic differ from inorganic products?) by that wonderful power of which, knowing absolutely nothing, we speak vaguely as the vital force. As in the world around us heat may pass into motion, so does the mechanical work of the body bear a strict relation to the amount of fuel consumed in respiration. The experiments of Mateucci demonstrate that electricity also is a powerful agent in the internal economy of a living creature.

With yet stricter truth may the vegetable kingdom be said to be built up out of the inorganic; for here the process is a direct one, whereas in the animal it is for the most part indirect. Here too, then, the forces of the inorganic world work unceasingly. "To suppose," says Dr. Carpenter, "that all the forces that are concerned in the growth and nutrition of countless generations of oaks were slumbering in the one acorn from which they all sprung, is to suppose a pure absurdity. The forces which carry on vegetable life are derived from without; are, in fact, the forces of nature, heat, light, chemical affinity; and that which does exist in the germ and which is peculiar to organization—the vital force, in fact—is simply directive power." Words which, while they impress us by their boldness, seeming as it were to bridge over an abyss of ignorance, awaken again that painful sense of man's limitations; for in the expression "the vital force is directive power," we stretch out our hands towards a truth that for ever eludes us, and find ourselves grasping an empty garment of words. Though it be good to recognise this, it is not good to be daunted or discouraged. If God